Exploring the research capabilities and applications of CREAIT's SEM-MLA facility

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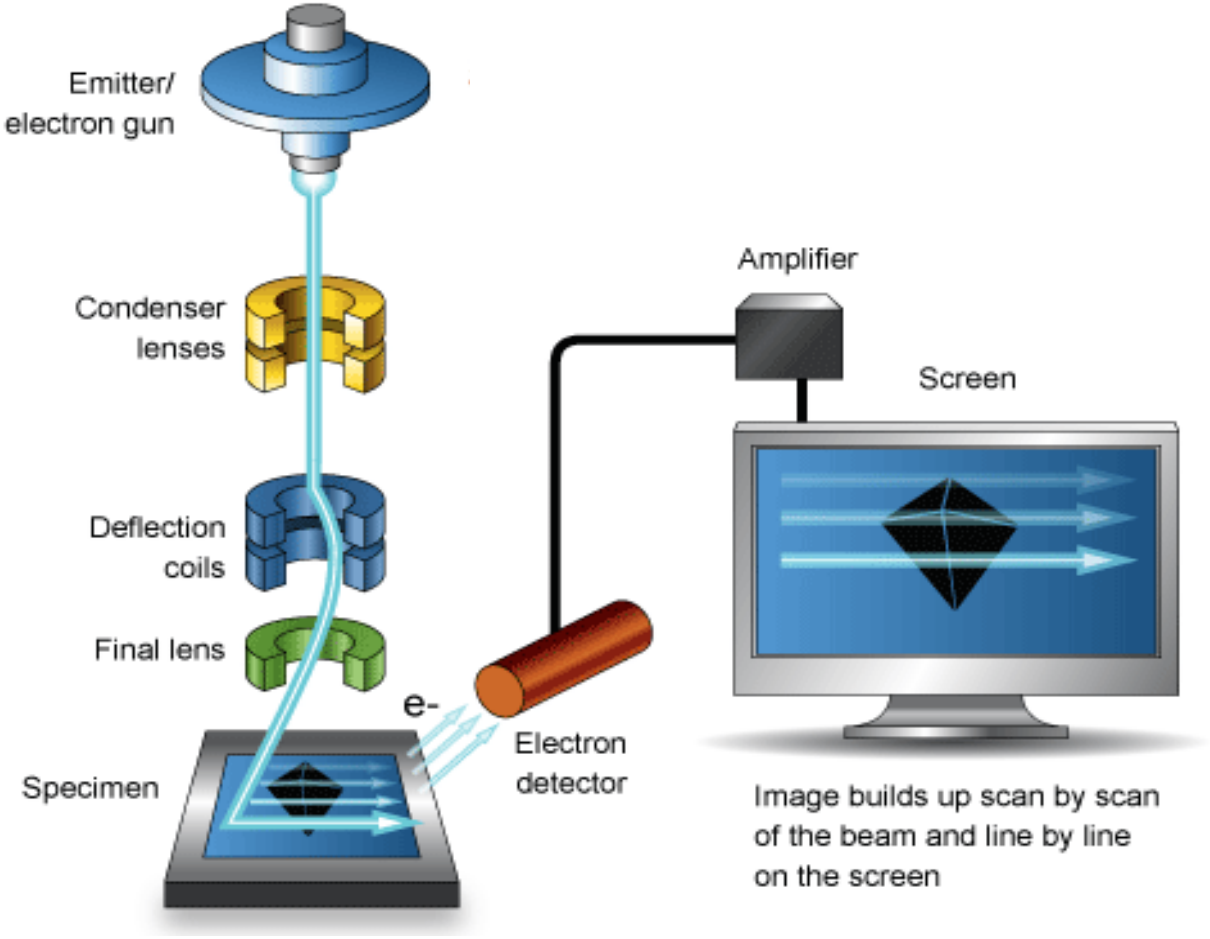
Introduction to SEM

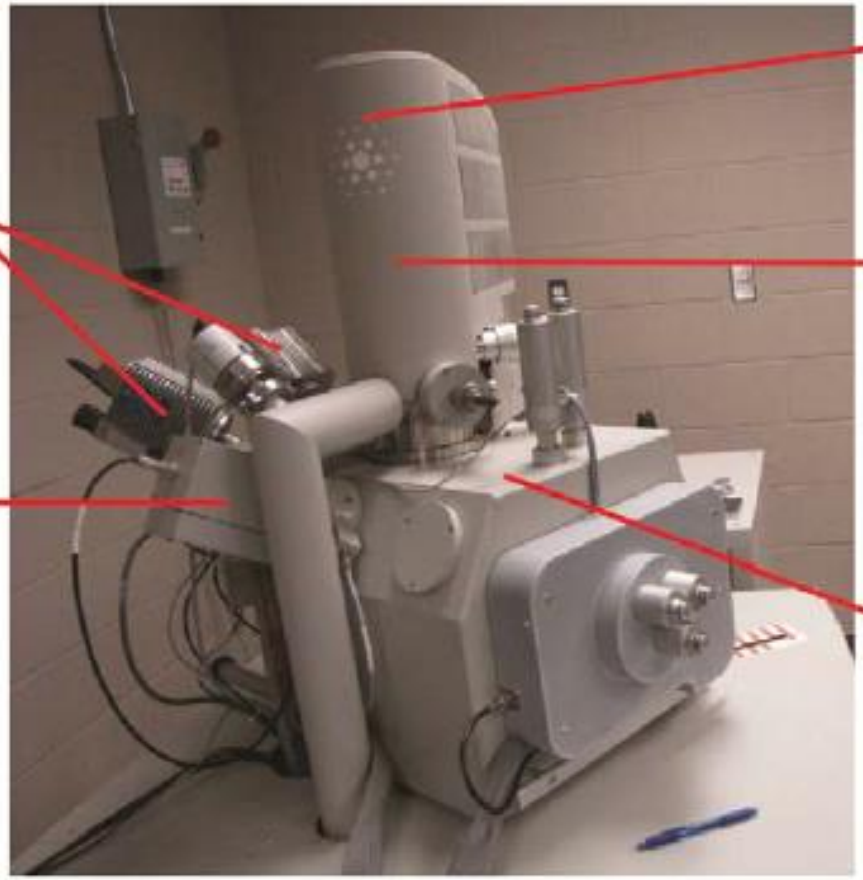
- **S**canning – moving back and forth
- **E**lectron – uses a focused electron beam
- **M**icroscopy – designed to enlarge an image

SEM layout and function



http://www.ammrf.org.au/myscope/sem/practice/principles/layout.php#detail

FEI Quanta 650 FEG

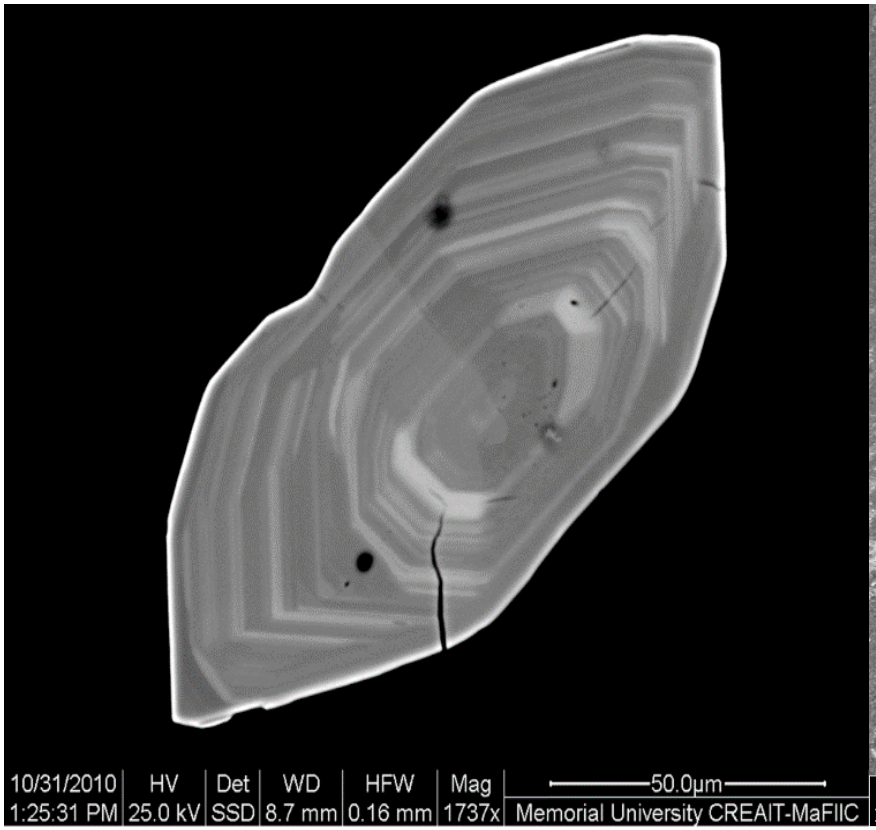


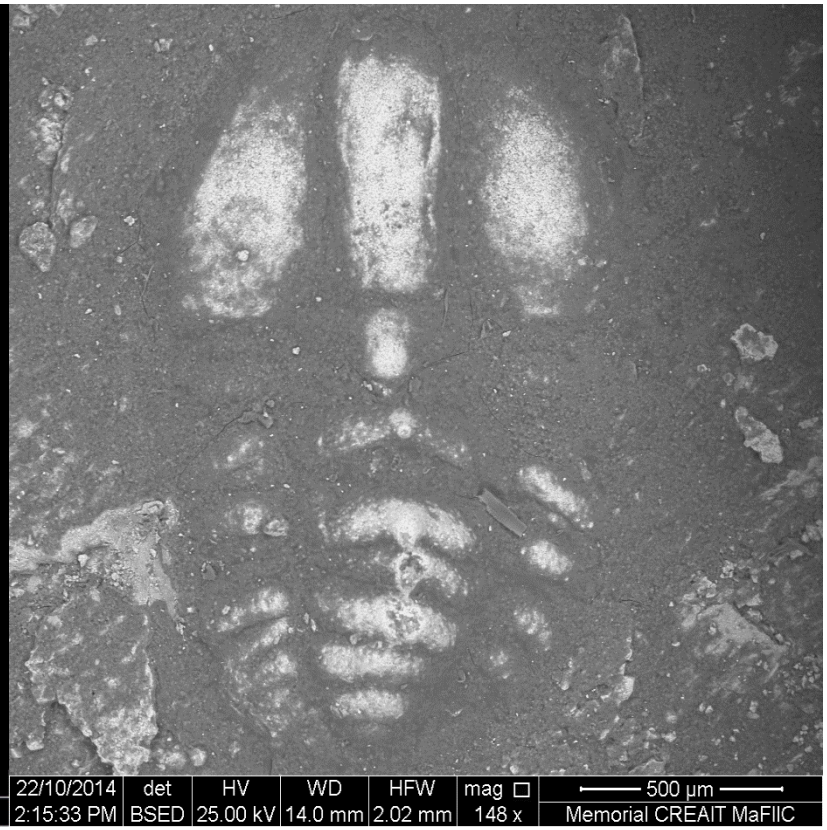
Bruker *XFlash*™ SDD x-ray detector

SEM Imaging & Analysis at MUN

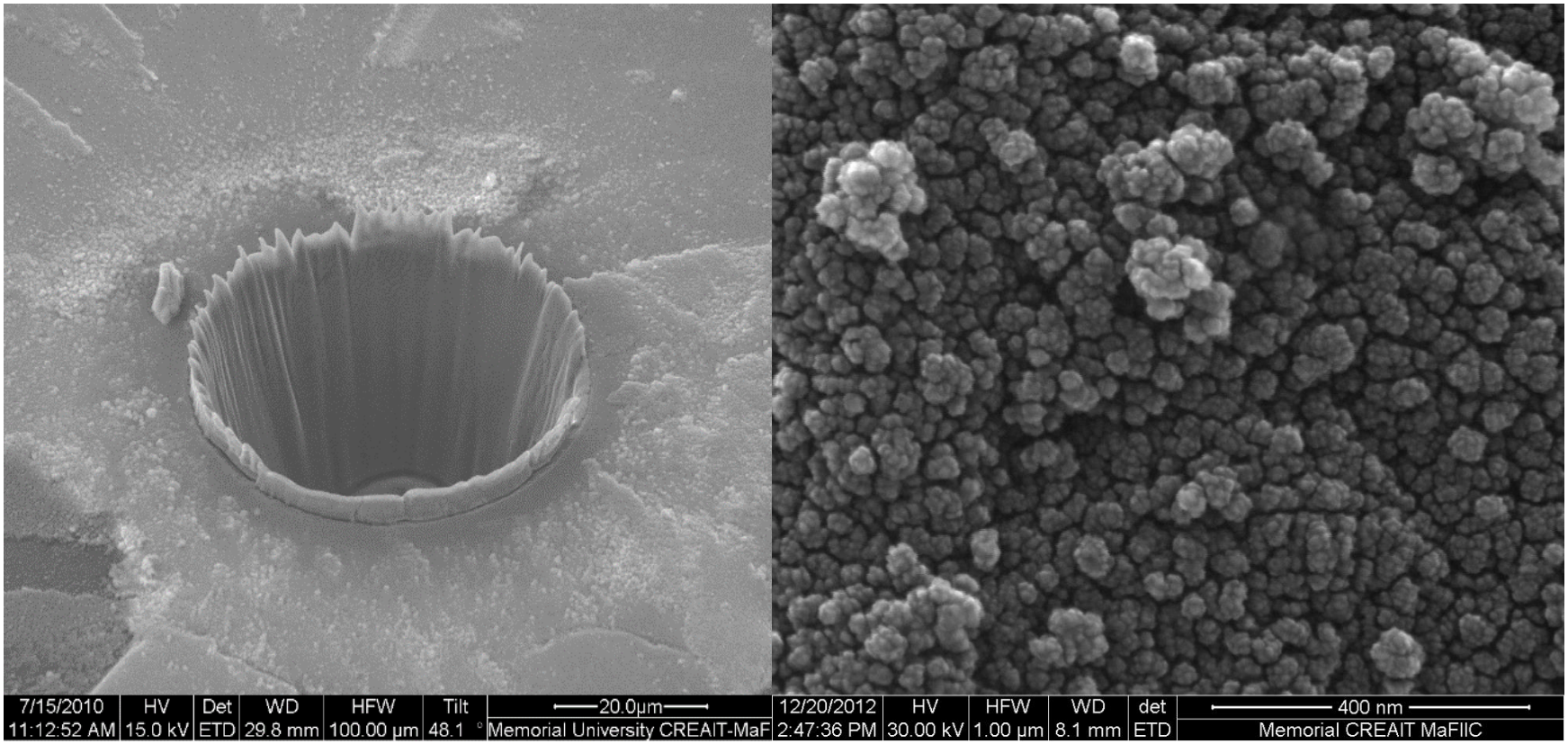
- **Three types of imaging:**
  - Back-scattered electron (BSE)
  - Secondary Electron (SE)
  - Variable pressure or environmental
- **Three types of analysis:**
  - Energy-dispersive X-ray spectroscopy (EDX)
  - Mineral liberation analysis (MLA)
  - Electron backscatter diffraction (EBSD)

Back-scattered electron (BSE) Imaging

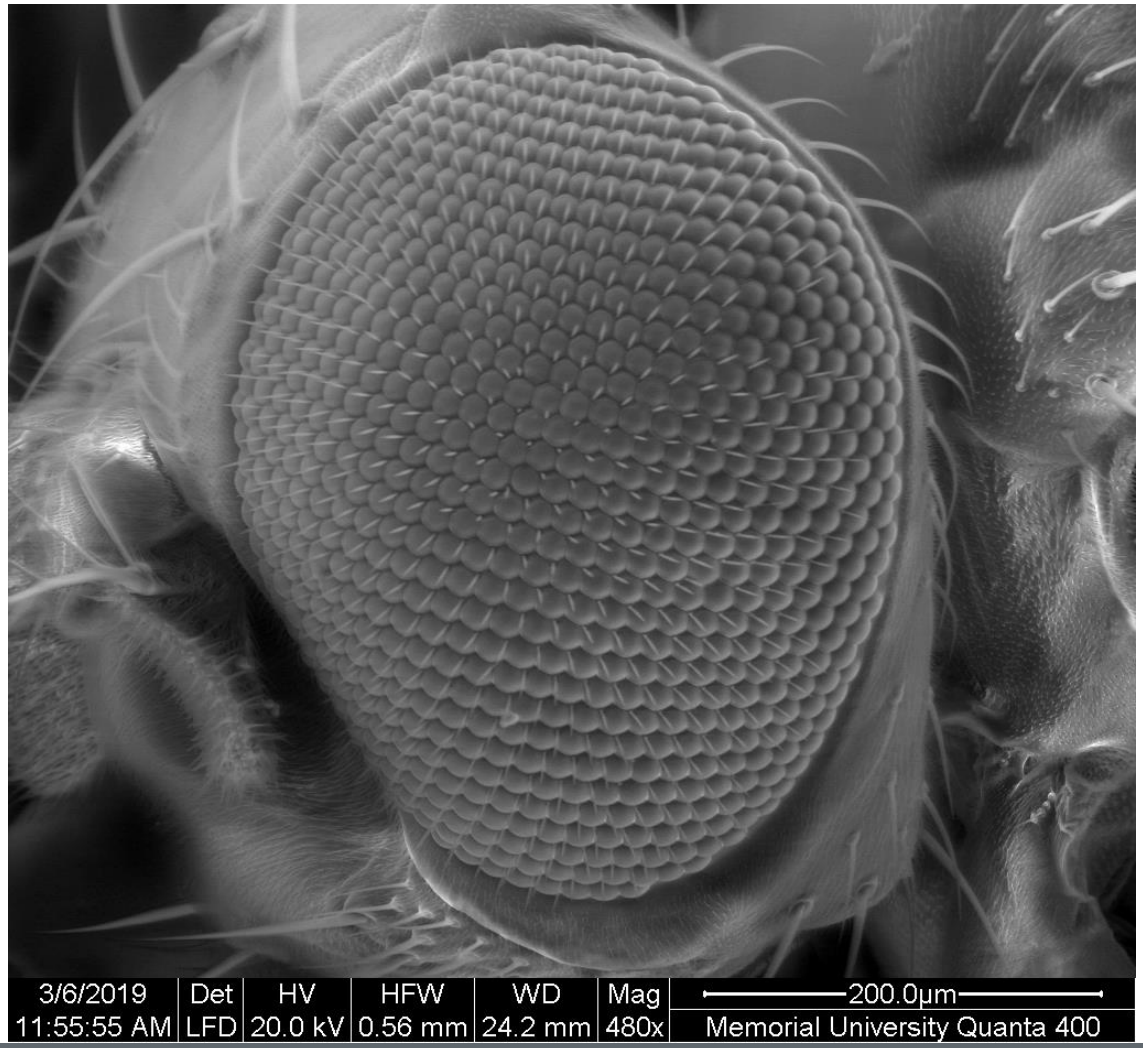




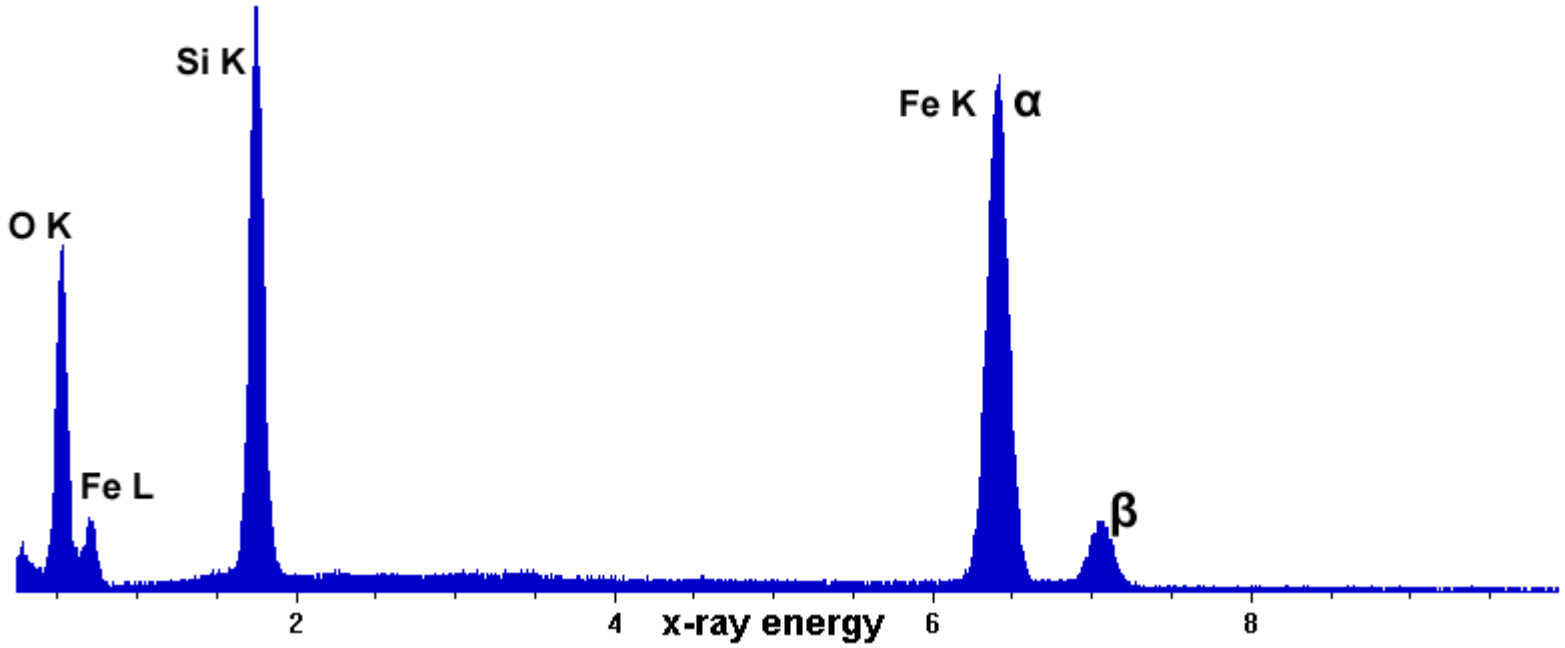
Secondary Electron (SE) Imaging



Imaging with Variable Pressure

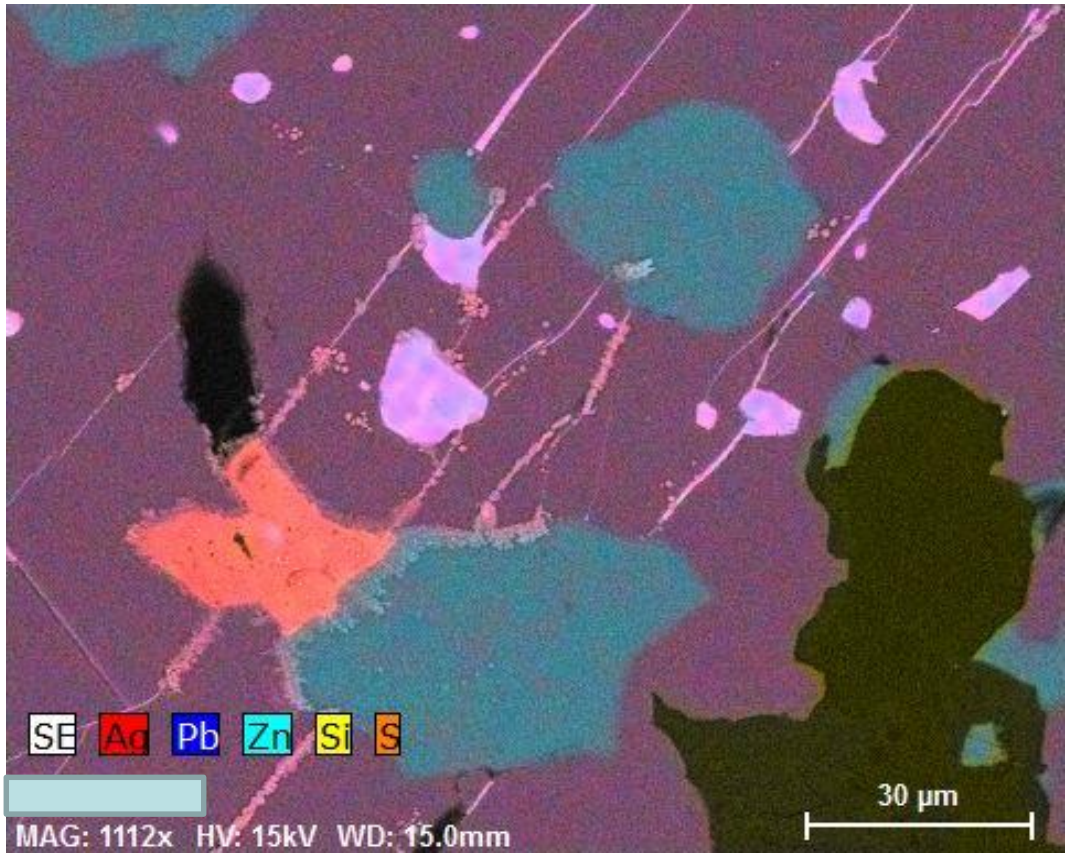


Compositional analysis via energy-dispersive X-ray spectroscopy (EDX)



Example EDX spectrum for Iron Silicate (Fayalite)

Compositional analysis via energy-dispersive X-ray spectroscopy (EDX)



Example EDX map of various sulfide minerals

Mineral Liberation Analysis™ (MLA)

- Automated mineralogy
- Owned by FEI Company (Now ThermoFisher)
- Software that works with SEM controller and Bruker EDX detector
- Can be applied to polished grain mounts or petrographic thin sections

Mineral Liberation Analysis™ (MLA)

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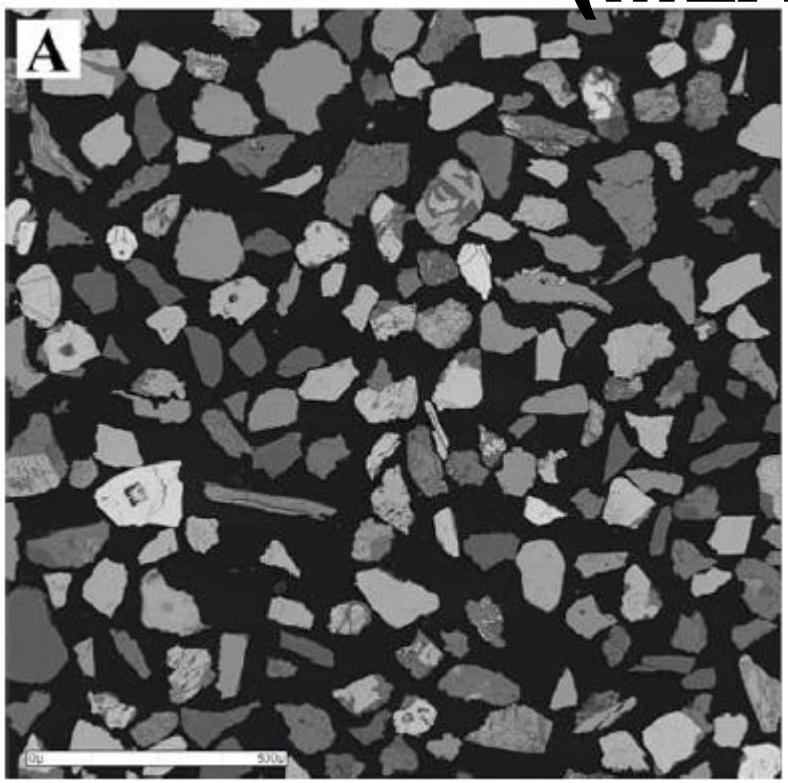
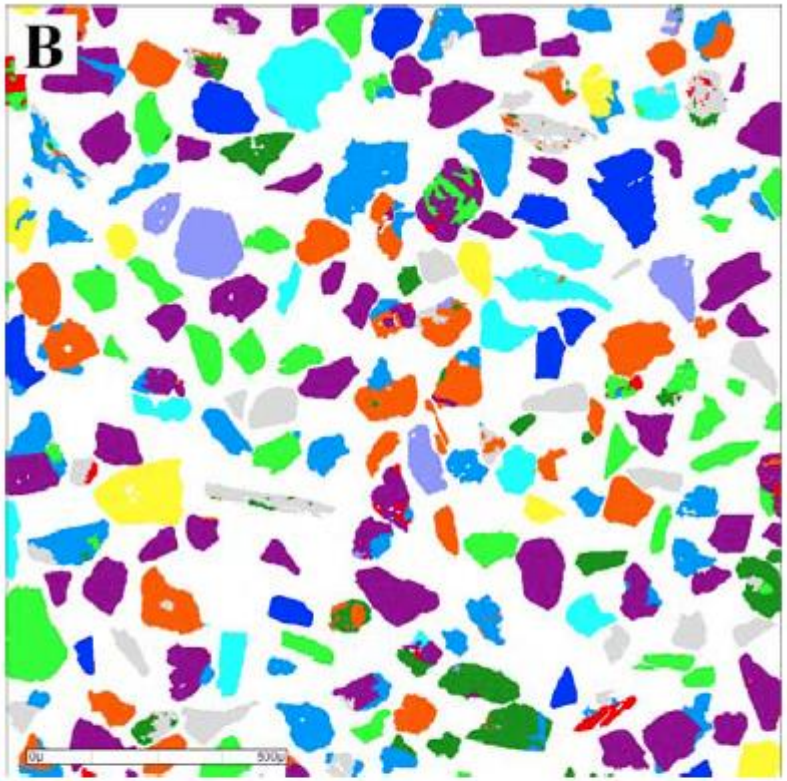
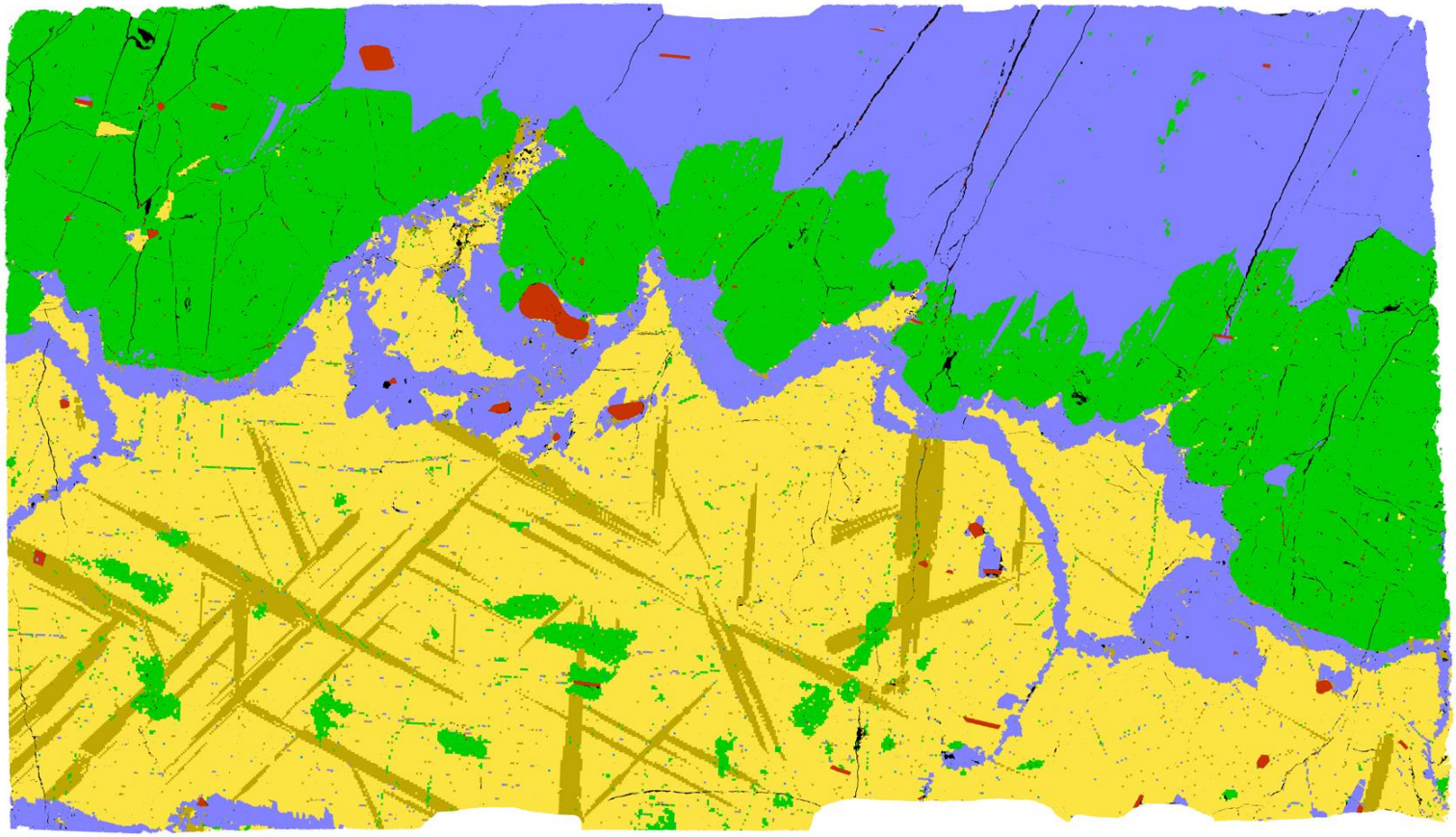




Ilmenite
Magnetite
Chromite
Calcite
Garnet
Quartz
Chlorite
Zircon
Allanite
Rutile
Epoxy
Other

Mapping minerals *in situ* 25 x 45mm thin section



MLA: *points of interest*

A variety of applications …

I. **Imaging with *secondary* and *backscattered* electrons**

II. **Particle analysis (i.e., image analysis via MLA™)**
   a) Modal proportions
   b) particle size data
   c) mineral associations
   d) approximate porosity

III. **"Large particle" analysis (e.g., standard 25x45mm section)**
   a) in situ analysis
   b) Preserve and highlights textures

IV. **Bright mineral searching**
   a) zircon, monazite, gold, silver, & other precious minerals

Electron backscatter diffraction (EBSD)

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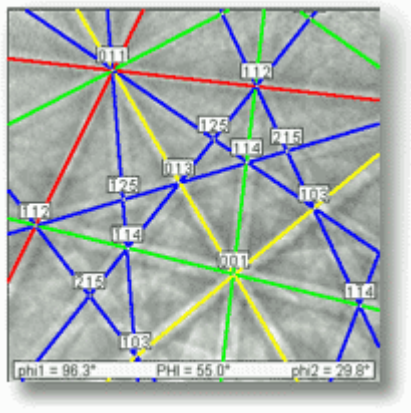
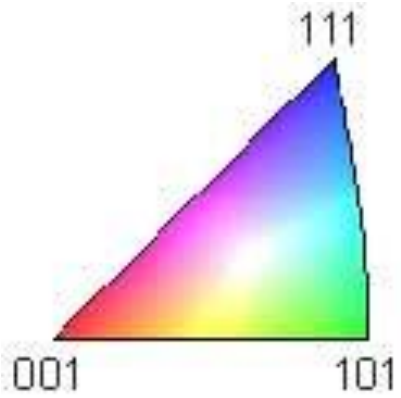
Crystallographic Information (EBSD)

- The arrangement of atoms in the specimen and their degree of order; only useful on single-crystal particles >20 micrometers
- These Orientation Imaging Micrographs give valuable information about sample's crystallographic orientation





Electron backscatter diffraction (EBSD)

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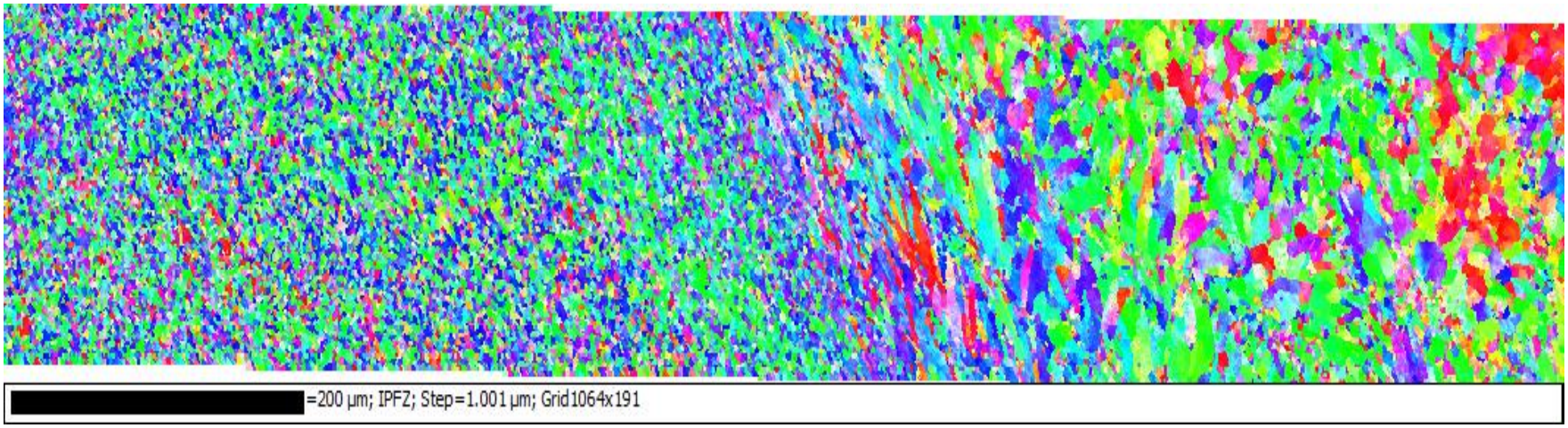

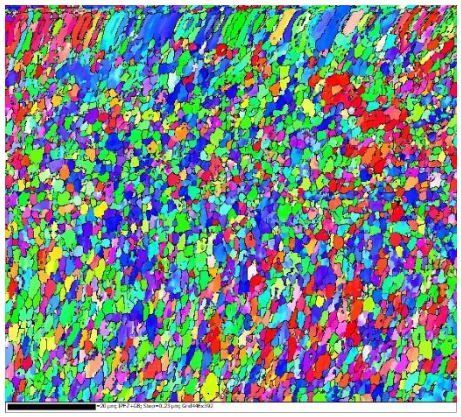

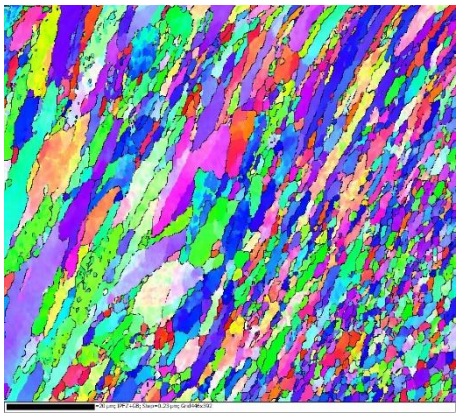

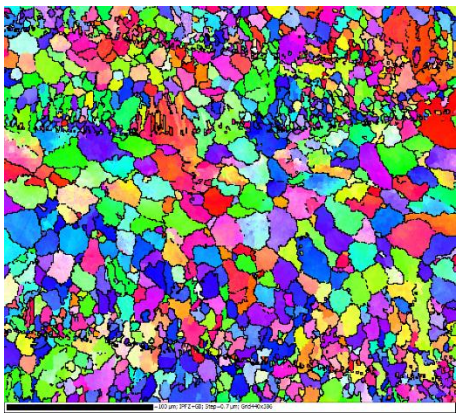

Electron backscatter diffraction (EBSD)

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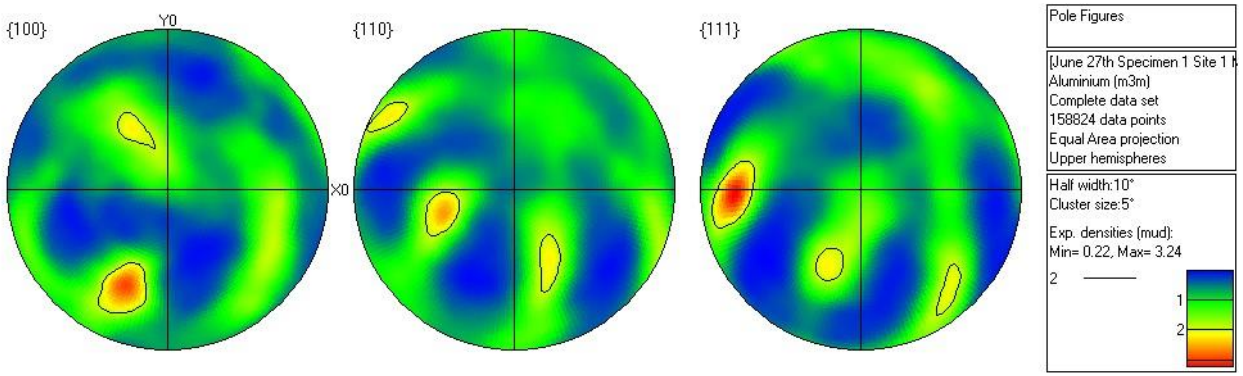
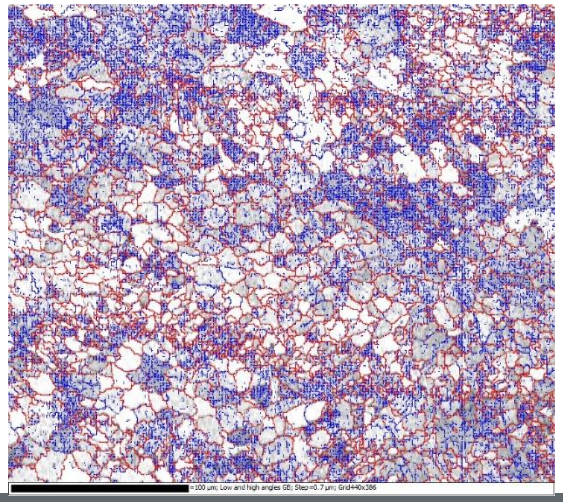
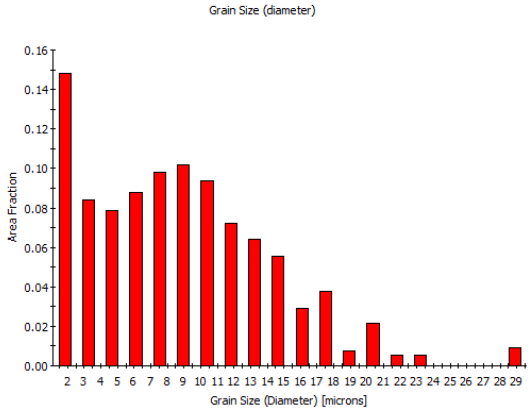
Post Processing Results:







Funding & Support

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